DoD Modeling and Simulation Update

Captain Jim Hollenbach, USN
Defense Modeling and Simulation Office
May 22, 1997

What's New?

- **Not the goal, not the strategy, not the plan; we're on course and making knots!**
- **High Level Architecture (HLA) has been mandated by USD(A&T) as the standard technical architecture for all DoD simulations.**
- **HLA transitions underway; much associated commercial and international activity**
- **Major progress on the other two legs of the Common Technical Framework and the provision of common services to the M&S community**
- **Major simulation acquisition programs are making headway**
- **Increased push for simulation in all areas of DoD operations, e.g., simulation-based acquisition (SBA)**
- **Much, much more!**

M&S Remains Critical to DoD's Ability to Meet its Mission

Continuing squeeze on DoD resources

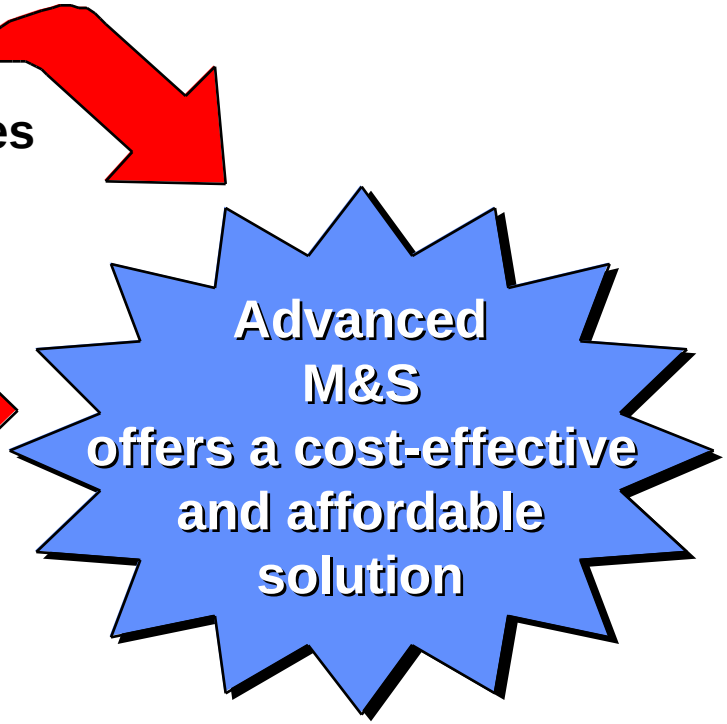
- shrinking, dispersed force structure
- competition for O&M funds limits field exercises
- need to carefully examine every investment

More demanding operational requirements

- new, more complex missions
- vastly expanding mission space
- increased complexity of systems and plans
- increasing demand for joint training
- security challenges (e.g., information warfare)

Much more technical capability at less cost

- communications
- computers
- advanced software technology
- displays/human-machine interfaces
- data storage and management



DoD M&S Vision

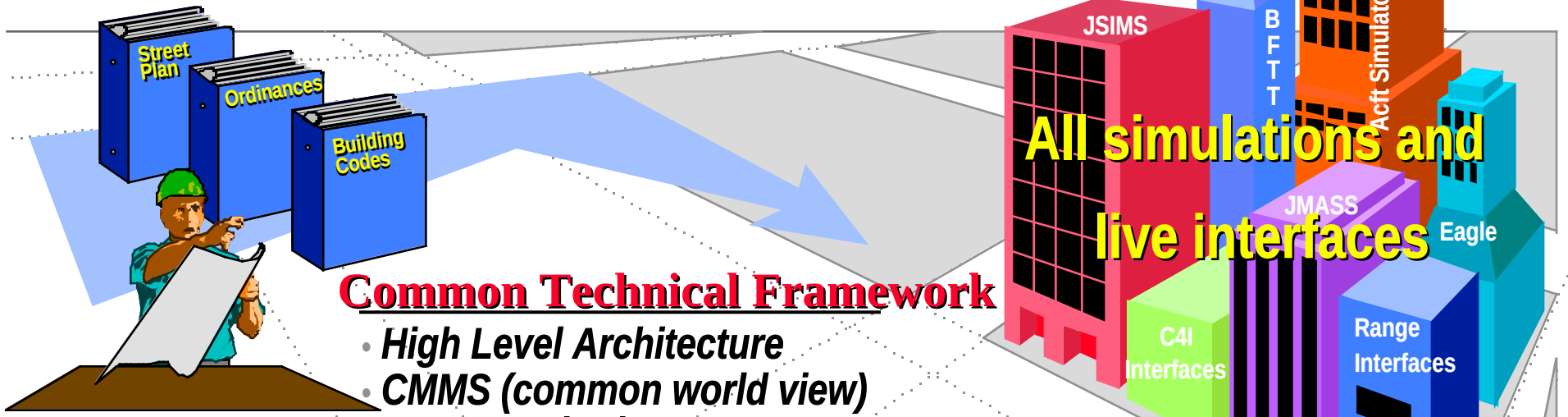
Defense modeling and simulation will provide readily-available, operationally-valid environments for use by DoD components

- **to train jointly, develop doctrine and tactics, formulate operational plans, and assess war fighting situations**
- **as well as to support technology assessment, system upgrade, prototype and full scale development, and force structuring.**

Furthermore, common use of these environments will promote a closer interaction between the operations and acquisition communities in carrying out their respective responsibilities. To allow maximum utility and flexibility, these modeling and simulation environments will be constructed from affordable, reusable components interoperating through an open systems architecture.

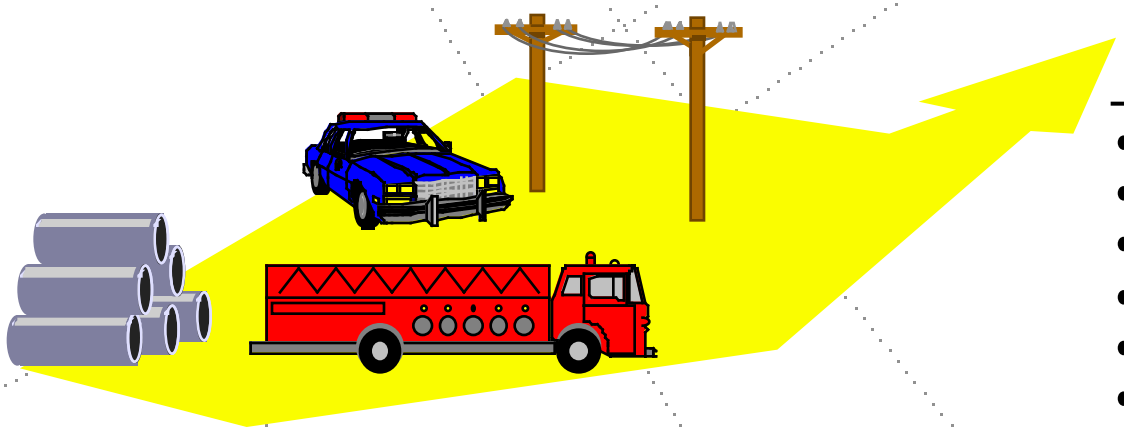
DoD Executive Council on Modeling and Simulation (EXCIMS), March 13, 1992

DoD M&S Strategy: An Analogy to City Planning



Common Technical Framework

- *High Level Architecture*
- *CMMS (common world view)*
- *Data Standards*



Common Services

- *Communication networks*
- *Environmental databases*
- *Resource repositories*
- *VV&A policy and procedures*
- *Help Desks (IAC & MSOSA)*
- *Supporting software/tools*

Payoffs: Interoperability and reuse = capability and cost-effectiveness

The Strategy is Being Executed Through a DoD-wide M&S Master Plan

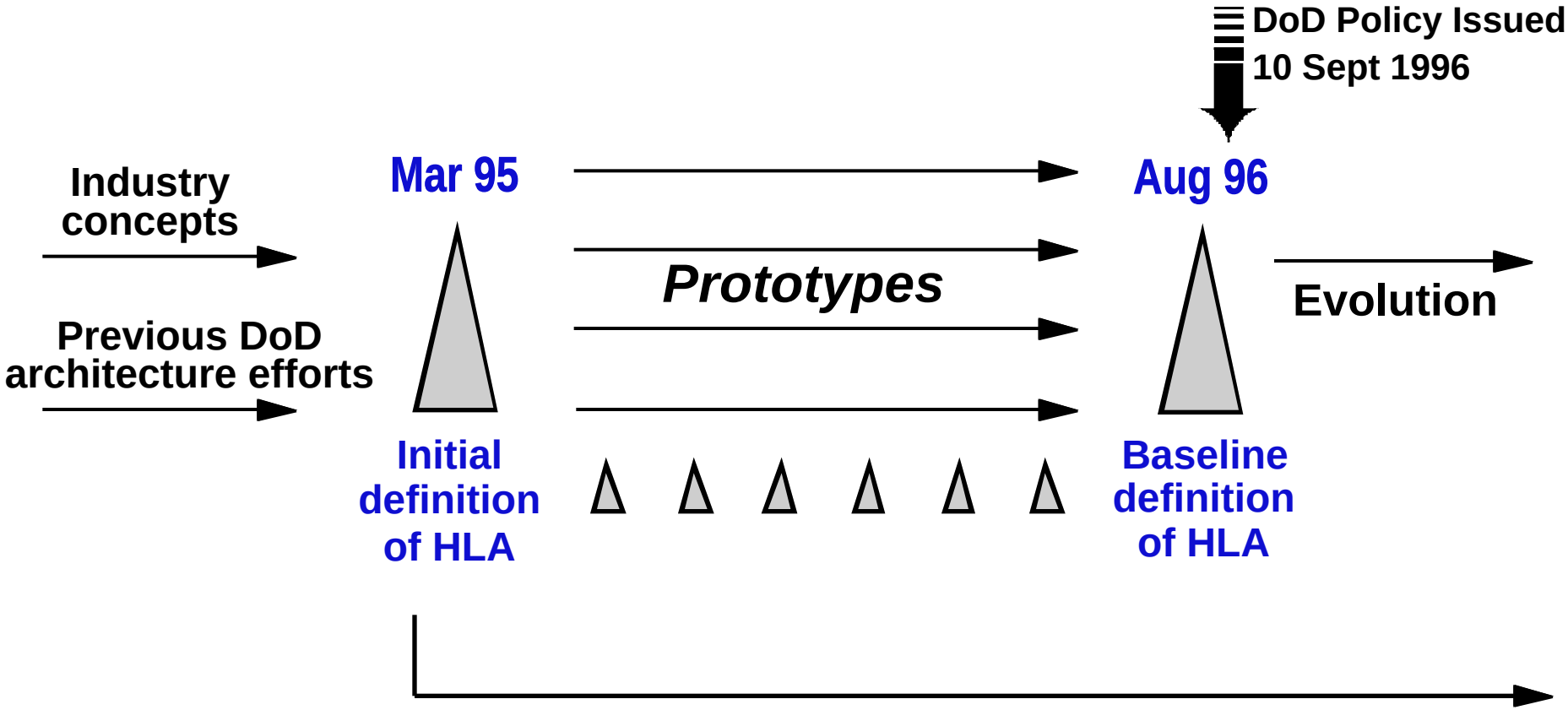
Objective 1	*Objective 2*	*Objective 3*	*Objective 4*	*Objective 5*	*Objective 6*
Develop a common technical framework for M&S	Provide timely and authoritative representations of the natural environment	Provide authoritative representations of systems	Provide authoritative representations of human behavior	Establish a M&S infrastructure to meet developer and end-user needs	Share the benefits of M&S
Sub-objectives	***Sub-objectives***		***Sub-objectives***	***Sub-objectives***	***Sub-objectives***
1-1 High-level architecture	2-1 Terrain		4-1 Individuals	5-1 Field systems	6-1 Quantify impact
1-2 Conceptual models of the mission space	2-2 Oceans		4-2 Groups and organizations	5-2 VV&A	6-2 Education
1-3 Data standardization	2-3 Atmosphere			5-3 Repositories	6-3 Dual-use
	2-4 Space			5-4 Communications	
				5-5 Coordination Center	

DoD 5000.59-P, Modeling and Simulation Master Plan, October 1995

Common Technical Framework

High Level Architecture (HLA)

High Level Architecture (HLA) Development Process Overview



DoD-wide Architecture Management Group

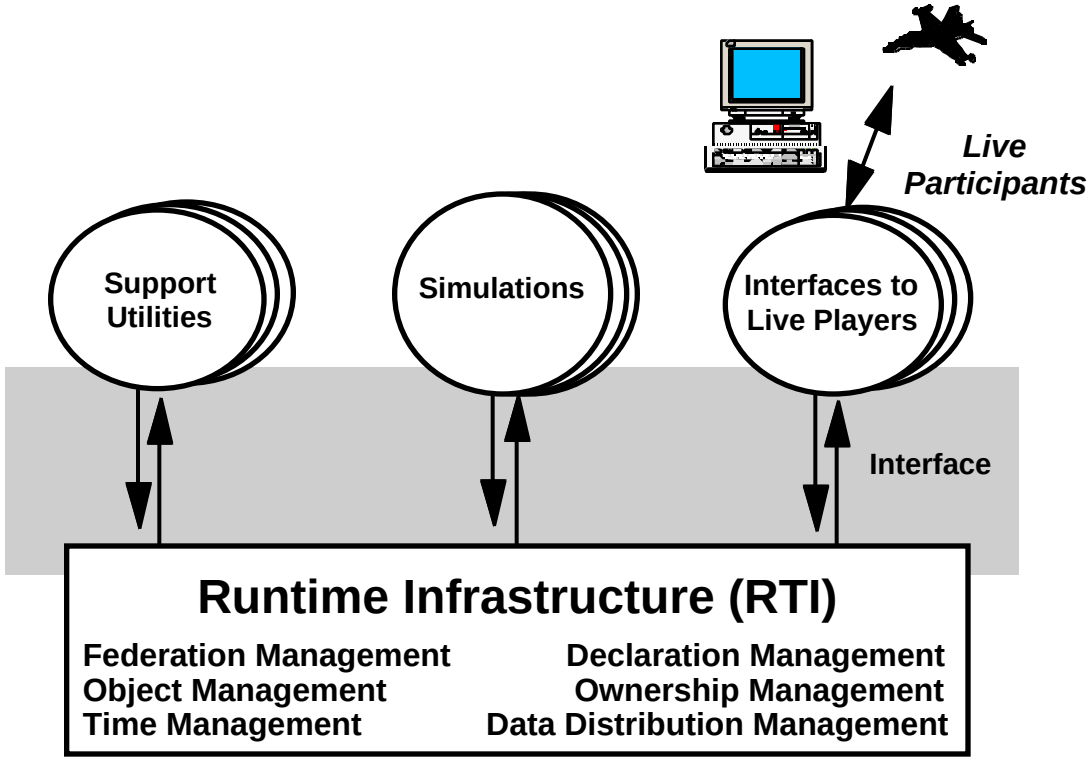
(16 major simulation programs; developers were 35% government, 12% FFRDC, 5% academia, 48% industry)

Rationale for HLA Design

- **Basic premises**
  - No single, monolithic simulation can satisfy the needs of all users
  - All uses of simulations and useful ways of combining them cannot be anticipated in advance
  - Future technological capabilities and a variety of operating configurations must be accommodated
- **Consequence**
  - Need composable approach to constructing synthetic environments
- **Resulting design principles**
  - Federations of simulations constructed from modular components with well-defined functionality and interfaces
  - Specific simulation functionality separated from general purpose supporting runtime infrastructure

The High Level Architecture (HLA)

- Architecture calls for a federation of simulations
- Architecture specifies
  - Ten rules
    - define relationships among federation components
  - Object Model Template
    - specifies the form in which simulation elements are described
  - Runtime Interface Specification
    - describes the ways simulations interact during an operation



The HLA is not the RTI; the HLA says there will be an RTI that meets HLA requirements but it doesn't specify a particular software implementation

Refining the HLA by Prototyping

- Over 25 different simulations
- One Runtime Infrastructure (RTI) prototype implementation
- Training, analysis, and acquisition support applications
- Unit, platform, and weapon system component level granularity
- Hardware-in-the-loop, human-in-the-loop, and closed-form simulations (live, virtual, and constructive)
- Both real-time and fast-as-possible discrete event simulations
- Both classified and unclassified federations
- Local and wide area networks (e.g., DSI, landlines) across the USA
- Run on Sun, Silicon Graphics, HP, and IBM workstations
- Addressed issues identified by the AMG and each protofederation

High Level Architecture Policy:
DoD's Standard Technical Architecture for Simulations

- **DoD Policy:**

"Under the authority of [DoD Directive 5000.59], and as prescribed by [the DoD Modeling and Simulation Master Plan], I designate the High Level Architecture as the standard technical architecture for all DoD simulations."

- **HLA supersedes Distributed Interactive Simulation (DIS) and ALSP**
- **"No Can" Dates**
  - **"No Can Pay"- first day of FY99**
    - **no funds for developing/modifying non-HLA-compliant simulations**
  - **"No Can Play"- first day of FY01**
    - **retirement of non-HLA-compliant simulations**
- **Waivers must be decided on a corporate basis**

Dr. Paul Kaminski, USD(A&T)
10 September 1996

HLA Supporting Software

- HLA is an architecture, not software -- however, to facilitate cost-effective implementation of HLA, DMSO is developing an initial suite of HLA supporting software
  - Open distribution in the public domain
  - Open access to specifications (e.g., OMT data interchange format) to foster development of commercial software to support HLA
  - Several DoD agencies have ongoing SBIR initiatives in development of HLA support tools
- HLA On-line
  - Open mailing list for updates on HLA and information on HLA supporting software
  - To subscribe, send a message to listproc@msis.dmso.mil and have the body of the message say:
    - subscribe hla_online <firstname> <lastname>

HLA Supporting SW

- Runtime Infrastructure Software - Available now
  - Order from DMSO homepage (http://www.dmso.mil/hla)
    - fill out form and submit
    - you will get confirmation by return email with FTP address and password for download
    - once registered you're automatically notified of new releases
  - Release includes RTI SW, installation guide and software, user documentation, test federate and sample applications
- Object Model Support Tools - In beta testing
  - Object Model Development Tools (OMDTs)
    - Automated support for development HLA Object Models (OMs), generation of RTI federation execution data, and exchanging OMs with the Object Model Library
  - HLA Object Model Library (OML)
    - Web-accessible library for storing and retrieving completed HLA object models
- Demos of above software available here today and tomorrow

Some Benefits of HLA Use

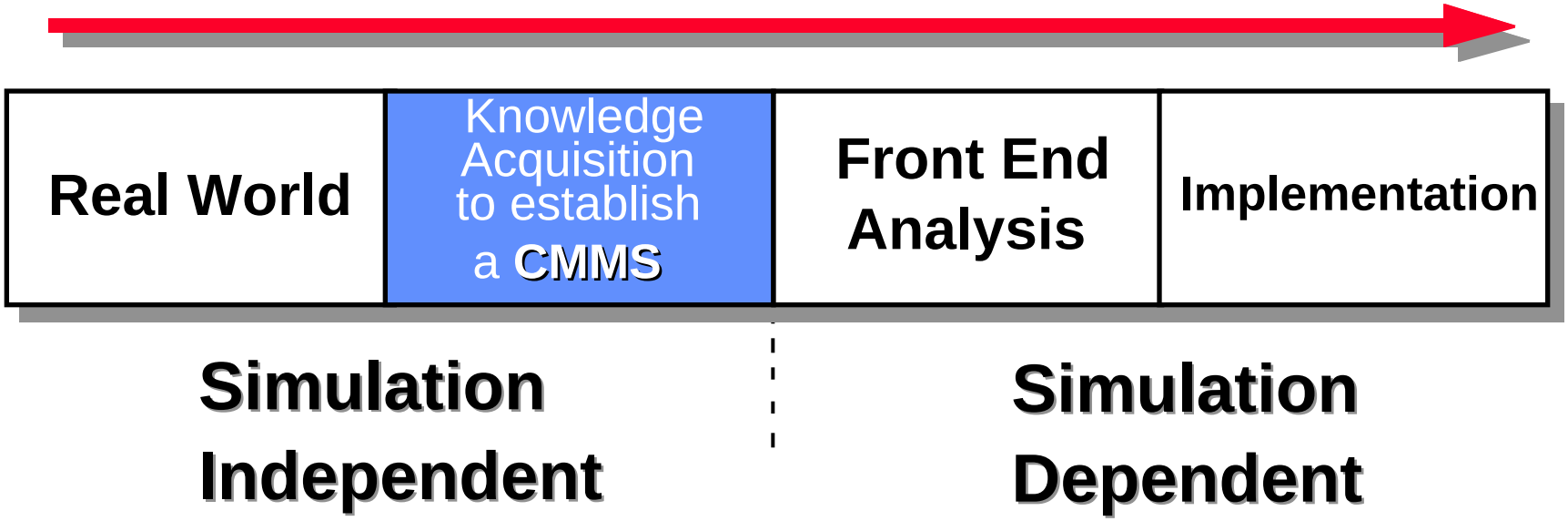
- New capabilities (ownership transfer, smarter data distribution, etc.)
- You don't have to build everything yourself; can use other people's stuff (when it makes sense!).
- Easier to reuse simulations (across functions and phases of your own program) and DoD can enjoy the reuse of your simulations (to support other objectives).
- You don't need to invest in a runtime infrastructure. Same infrastructure and interfaces can be used for a wide variety of simulation applications.
  - Large and small; real-time and managed time; local and distributed
- Applications benefit from improvements in infrastructure technologies without having to pay for them.
  - Improved performance infrastructure can be inserted without an impact on applications

Common Technical Framework

Conceptual Models of the Mission Space (CMMS)

Conceptual Models of Mission Space (CMMS)

Simulation Development Process



Every simulation developer builds something like a CMMS. The problem has been that they aren't authoritative and we throw them away.

CMMS Responsibilities

- **Warfighters:**
  - **acting as the authoritative source for how the world works**
  - **specifying mission-essential task lists and doctrine**
- **Simulation developers:**
  - **cooperatively doing the knowledge acquisition**
    - **JSIMS & JWARS doing initial work now**
  - **populating the CMMS database**
- **DMSO:**
  - **developing the database management system**
    - **prototype demo available here today and tomorrow**
  - **providing knowledge acquisition teams with technical support (e.g. common semantics and syntax, data interchange formats)**
  - **registering the CMMS data provided by the simulation developers**
  - **allowing wide access to the CMMS database as it is filled**

Why Should I Care About the CMMS?

- Provides a direct link between the warfighter and the developer for credible, trusted simulations
- Everybody doesn't have to do all Knowledge Acquisition by themselves -- can reuse others' KA
- Forces the use of authoritative data sources (warfighter in control), provides traceability for VV&A
- Improves chances for interoperability with other simulations
- Means to link M&S developers, trainers, and doctrine developers
- May provide means to alert developers of need for updates

Common Technical Framework

Data Standards

Data Standards
Program Thrusts

1. Common Semantics and Syntax (CSS)
   The logical structure and content (meaning) of any specific model or data element using a standard recognized by all

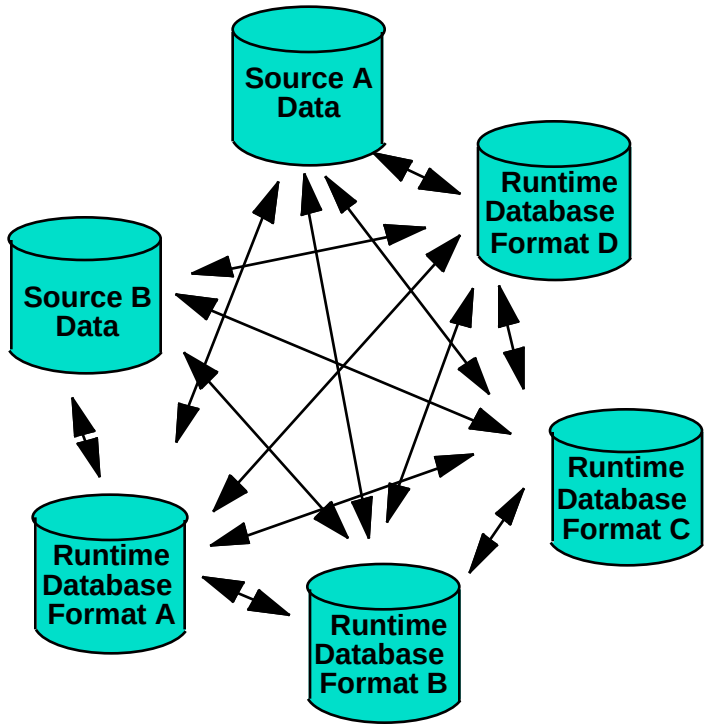
2. Data Interchange Formats (DIF)
   The physical representation (BNF, SQL, bits and bytes) of data which programmers employ to interchange complex data fields

3. Authoritative Data Sources (ADS)
   Where to go for the best data

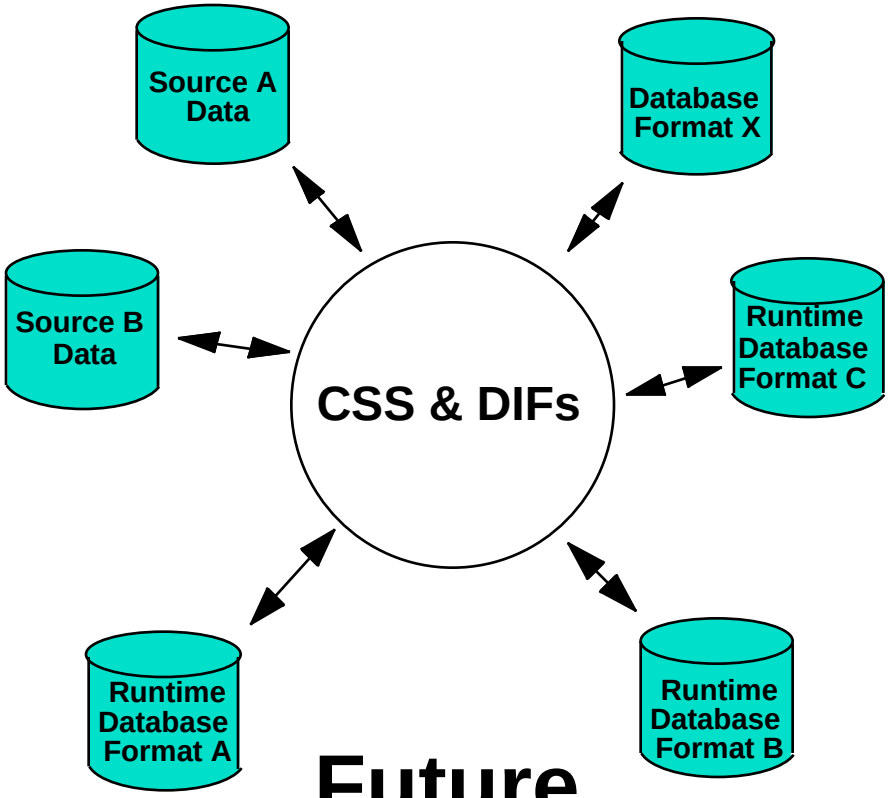
4. Data Quality practices (DQ)
   The means to ensure your databases are complete and coherent

5. Data Security practices (DS)
   A range of protection/release policies

Speaking a Common Language



Today



Future

Data Standards - Progress to Date

- Common Semantics and Syntax
  - verb dictionary developed for CMMS
  - HLA Object Model content dictionary in initial development
  - 4793 data elements submitted to DISA for DoD-wide standardization
- Data Interchange Formats:
  - developed for Object Model Template, CMMS, and Order of Battle
- Authoritative Data Sources:
  - have designated over 150 authoritative data sources
  - approximately 200 more in work
- Data Quality:
  - VV&C guidelines drafted; out for comment this summer
  - developing general-use data quality checking tools
- Data security
  - testing Forteza cards, but really not much so far

Common Services

DoD M&S Executive Agents

Four DoD-Wide M&S Executive Agents

Appointed by USD(A&T) under the DoD M&S Management Directive:

- **Terrain -**
  NIMA Terrain Modeling Project Office
  POC: Kelly Lillegard, (301) 227-3492, lillegardk@nima.mil
- **Oceans -**
  Oceanographer of the Navy
  POC: Dr. George Heburn, (202) 404-1426, oceanea@msis.dmso.mil
- **Air and Space -**
  Air Force Combat Climatology Center (AFCCC)
  POC: CDR Tim Cummings, (618) 256-3902, msea@thunder.safb.af.mil
- **Foreign Forces and U.S. National and Joint Intelligence Process -**
  Defense Intelligence Agency
  POC: Chris Guenther, (202) 231-3101, rguenthe@msis.dmso.mil

Executive Agent Activities

- Requirements and capabilities assessment
- Just-in-time production
  - Including commercial market place for environmental data
- Data interchange standards
  - e.g., Synthetic Environmental Data Representation Interchange Specification (SEDRIS)
- Data access means
  - e.g., Master Environmental Library (MEL) within MSRR
- Dynamic effects - expertise and algorithms
  - But EAs do not build software
- CMMS development

How M&S Executive Agents Can Help You

- Provide SMEs to developers (offering them an extended staff)
- Help assess/refine requirements and identify/share capabilities
- Facilitate just-in-time, cost-effective production of data
  - including stimulation of commercial market place
- Set data interchange standards
  - makes it much easier to use data from other simulations and sources
  - Key project: Synthetic Environmental Data Representation Interchange Specification (SEDRIS) as new environmental standard
- Provide developers a means to access data
  - Key project: Master Environmental Library (MEL)
- Advise PMs on dynamic effects representation and algorithms
  - But EAs do not build software
- Provide VV&A assistance and sign-off
- Other direct support (e.g., reference data sets, pilot projects)

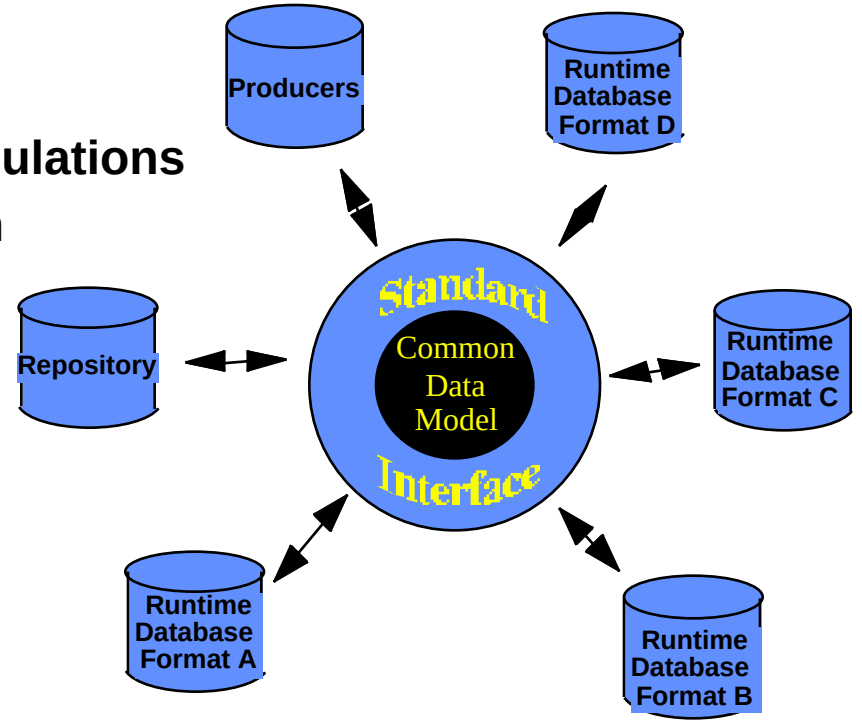
Some Examples of Benefits to Programs

- **High-Resolution Terrain Data Study conducted at the McKenna Military Operations in Urban Terrain (MOUT) training facility at Ft Benning**
  - **provided to the Army Soldier Support Command and the Virtual Proving Ground Program for use in high-resolution T&E activities**
- **Joint Surf Zone Model development project for the integration of effects models in the dynamic surf zone environment**
  - **coordinated with the Advanced Amphibious Assault Vehicle (AAAV), the Landing Craft Air Cushion (LCAC) programs at MARCORSYSCOM, and Naval Air Warfare Center - Training Systems Division**
- **Littoral environments data generation project**
  - **providing reference data sets to the Joint-Logistics-Over-The-Shore (JLOTS) Program Office for testing and evaluating current procedures and equipment used in movements ashore from floating piers, man-made causeways, and over ocean bottom to staging areas beyond the beach**

Synthetic Environment Data Representation and Interchange Specification (SEDRIS)

- **STATUS QUO**
  - No standard data model
  - Limited support to heterogeneous simulations
  - Indeterminate interchange mechanism
  - Expensive database conversion

- **SEDRIS ADVANTAGES**
  - Complete representation
  - Enables interoperability
  - Consistent, lossless interchange
  - 100X reduction in conversion costs



CY 1995 ---------- 1996 ---------- 1997 ---------- 1998----------1999

SEDRIS Demonstrations

- **SEDRIS demos available here today and tomorrow**
  - **SEDRIS Viewer application extracting and displaying SIMNET, STOW and CCTT 3D models and textures**
  - **NIMA provided VPFView and SEDRIS Viewer extracting and displaying 2D Vector Product Format (VPF) databases**

- **Key points:**
  - **SEDRIS API and Viewer can be used to extract and display from very different databases**
  - **SEDRIS is a powerful tool and investment in software is reusable**

Common Services

Verification, Validation, and Accreditation (VV&A)

VV&A

- Verification, validation and accreditation (VV&A) supports:
  - establishing the credibility of models and simulations
  - mitigating risk by identifying potential errors and development problems early in the development cycle
- What have we done?
  - Supported a VV&A Technical Working Group
    - *Community forum for addressing VV&A Issues*
  - DoD Policy Instruction 5000.61, November 1996
    - *Established roles and responsibilities, common terminology*
  - DoD VV&A Recommended Practices Guide
    - *Defined underlying philosophy, principles and a generic process for VV&A*
- Next steps:
  - testing and refinement of the recommended practices
  - better integration with the development processes and identifying key decision points

Common Services

M&S Resource Repository (MSRR)

Modeling and Simulation Resource Repository (MSRR) - What is it?

- A set of resources stored on a distributed network of computers, linked by special application software and WWW protocols
- Resources may include:
  - models, simulations, databases, metadata, CMMS, simulation and federation object models, VV&A histories, standards, supporting software/tools, facilities/organizations, etc.
- Characteristics of MSRR
  - serves developers, users, operators, managers
  - access/security controls
  - efficient, flexible search mechanisms
  - contents registered and configuration managed
  - resources maintained by owners
  - unclassified (Internet) and classified (SIPRNet)
- A team effort
  - DMSO developing the software and providing management
  - Entire M&S community doing the populating

MSRR

- **MSRR benefits:**
  - **A user-friendly way to find stuff you need**
  - **More reuse, less duplication**
  - **Assured currency because MSRR resources are owned and maintained by their owners**
  - **Faster, cheaper, less risky simulation developments and simulation exercise planning**
  - **A controlled way to share what you build**
- **Status:**
  - **Initial prototype available 30 May 97 (www.msrr.dmso.mil)**
  - **Full prototype this fall**
  - **Only sparsely populated thus far**
- **MSRR demos available here today and tomorrow**
  - **How to search for and access resources**
  - **How to register information in the repository**

Common Services

Help Desks

DoD-Wide M&S Help Desks

- **Defense Modeling, Simulation and Tactical Technology Information and Analysis Center (DMSTTIAC)**
  - **a classic IAC**
  - **provides scientific and technical information and analysis services**
  - **serves multiple communities: M&S, Special Ops, T&E, and Tactical Warfare**

- **Modeling and Simulation Operational Support Activity (MSOSA)**
  - **a prototype DMSO-funded and directed, contractor-staffed activity**
  - **focus on M&S employment and management needs**
  - **a dedicated staff of M&S experts (most ex-military)**

MSOSA Services Provided

- **Assistance**
  - Help customers define their requirements for operational employment of M&S
  - Help customers identify existing assets that meet their needs
  - Respond to customer requests for M&S advice on operational employment of M&S
- **Coordination**
  - Coordinate customer access to required M&S assets
  - Help customer coordinate their M&S exercise events within overall DoD exercise calendar
- **Information Transfer**
  - Facilitate customer access to MSRR, IACs, and other data/ information sources
  - Identify and facilitate transfer of information on M&S policies, VV& A histories, lessons learned, M&S development programs
  - Answer specific M&S questions

Coming Soon:
A New Super-IAC

- **DMSTTIAC and MSOSA services will be combined in a "one-stop shopping" M&S IAC.**
- **Dedicated to serving the M&S community**
- **Will optionally provide a wide range of other general support services**
  - **e.g., MSRR technical/management support; education services; HLA compliance testing; impact assessment; software and document distribution; dedicated support tasks**
- **A new procurement underway later this year as a cooperative effort between DMSO and the Defense Technical Information Center (DTIC)**

Commercial and International Activities

- Much HLA interest in commercial arena
  - commercial products are emerging
  - interests beyond defense
- DIS Workshop has been reconstituted as the Simulation Interoperability Standards Organization (SISO) to serve the full breadth of the M&S community, beyond DoD
  - Will develop HLA as an IEEE standard
  - Simulation Interoperability Workshops each spring and fall
- Foreign nations have begun to build HLA-based simulations
- The NATO Military Committee and Council of National Armament Directors (CNAD) have chartered a Steering Group on M&S
  - will draft first-ever NATO M&S Master Plan, including interoperability and reuse standards
  - HLA/Common Technical Framework accepted as a baseline
  - HLA workshop this July in The Hague

Conclusion

- **This stuff is hard; the challenges are abundant**
- **The DoD M&S community is working together as a team**
- **The M&S Master Plan is being executed successfully, with the HLA as the cornerstone**
- **Visions and slideware have been turned into software**
- **The DoD revolution in M&S is thriving and succeeding!**

Q&A

Questions...comments...
tomatoes?